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Performance of Turbine-Type Flowmeters in Liquid Hydrogen

The problem:

Development of cryogenic technology has, in recent years, seen a marked increase in the use of large amounts of liquid hydrogen as a space vehicle propellant fuel and in laboratory use aimed at improving its utility in the space fuel area. Turbine-type flowmeters, because of ease of their installation and reliable operation, are generally used for measuring the flow of this liquid. However, there are few published reports of firsthand experience with volumetric turbine-type meters in such applications.

The solution:

Calibration testing involving 3/4-inch to 2-inch commercially available flowmeters operated in liquid hydrogen. The calibration factor (pulses per unit volume) below nominal full scale remains constant over only about one-sixth of the flow range obtained with water, although the factor is reproducible over much wider flow ranges. Nonreproducibility is such that the maximum deviation of the factor from its mean value at nominal full scale ranges from 0.5 to more than 1 percent, depending on the history of use; the probable deviation is one-half of the maximum deviation. A 50-percent probability exists that the calibration factor of a meter in liquid hydrogen at full scale can be predicted to within 0.7 percent from the

water calibration. A 90-percent probability exists that the prediction can be made to within 1.0 percent if there are prior data on meters of the same design, and to within 1.5 percent if there are no such data; in the latter case, the calibration factor in liquid hydrogen must be assumed to be 0.5 percent higher than the calibration factor in water. The influence of piping conditions and of pressure drop are also taken into consideration.

Note:

Further information concerning this innovation is presented in NASA TN D-3770, "Performance of Turbine-Type Flowmeters in Liquid Hydrogen," by Herbert L. Minkin, Howard F. Hobart, and I. Warshawsky, December 1966, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Inquiries may also be directed to:

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Patent status:

No patent action is contemplated by NASA.

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Category 01

